Impact of Tropical Cyclones and Storm Surges on Agriculture in India

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Topics

• India- some salient features
• Tropical Cyclones in Indian Region
• Storm Surges and their Prediction
• Case studies of impact of TCs in the coastal regions of India
• Agromet Advisory Service and Economic Impact Assessment
Agriculture: Primary Sector

- Indian agriculture is inefficient and labor intensive.
- Animals are frequently used for power.
- The village is the focus of life for 74 percent of the Indian population with an estimated 580,000 villages.
- Approximately 2/3 of India's huge working population (63 percent) depends directly on the land for its livelihood.
- Substantial progress toward modernization has been made in the Punjab's wheat zone.
- Half of all rural families either owned as little as a half hectare (1.25 acres) or less, or no land at all.
- Land consolidation efforts have had only limited success, except in the states of Punjab, Haryana, and Uttar Pradesh.
**Major crop zones:**

1. **Wheat.** Dry northwest notably in the Punjab and neighboring areas of the Upper Ganges. Many gains from the Green Revolution through the introduction of high-yielding varieties developed in Mexico.

2. **Rice.** Moist east and a summer monsoon drenched south. More than 1/4 of all of India's farmland lies under rice cultivation, most of it in the states of Assam, West Bengal, Bihar, Orissa, and eastern Uttar Pradesh. This area has more than 100 cm (40 inches) of rainfall. India has the largest acreage of rice among the world's countries. Yields per hectare are still low at below 1,000 kg (900 lbs./acre), however.

3. **Coconut.** Malabar Coast. (Kerala)

4. **Millet.** Southwestern India. A cereal grass, Setaria italica, extensively cultivated in the East and in southern Europe for its small seed or grain, used as food for man and fowls, but in the U.S. grown chiefly for fodder.

5. **Groundnut.** Kathiawar Peninsula.

6. **Cotton.** West-Central India (Deccan Plateau).

7. **Chick Peas.** Northwest.

8. **Plantation.** Northeast.
Livestock:

- India has more livestock than any other country in the world.
  - Cows - 200,000,000
  - Water buffalo - 60,000,000
  - Goats and sheep - 60,000,000
  - Horses, donkeys, and elephants - 5,000,000
- Sheep are of major importance in the drier west where the Islamic population is clustered.
- Buffalo is dominant in the Ganges Delta and coastal regions.
- Cattle (particularly the Brahman or Zebu breeds) are found throughout India.
Average TC Movement in Different Basins
Tropical Cyclones in Indian Region

• Only 7% of the world’s total TC production, takes place in Indian Region.
• There are two major TC seasons: Pre-monsoon (April-May) and Post-monsoon (Oct-Dec).
• Bay of Bengal is 3 times more prone to TC as compared to Arabian Sea.
• On an average only ONE TC per year attains Hurricane Intensity in the region.
• The region has highest population density and shallowest coastal bathemetry in the world-highest vulnerability to Storm surge.
TROPICAL CYCLONE VULNERABILITY
STATES OF INDIA

• West Bengal
• Orissa
• Andhra Pradesh
• Tamilnadu
• Pondicherry
• Kerala
• Lakshadweep
• Karnataka
• Goa
• Maharashtra
• Gujarat
• Andaman & Nicobar Islands
• Diu & Daman
Potential Impact upon Landfall of a Tropical Cyclone
Storm Surge

A Storm Surge is an abnormal rise of sea level caused by a cyclone moving over a continental shelf.
## DEATHS IN TROPICAL CYCLONES

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<thead>
<tr>
<th>YEAR</th>
<th>COUNTRIES</th>
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- 74% events in the Bay of Bengal
- 59% of Bay events in Bangladesh
- 70% Deaths in Bangladesh
## List of Cyclone Disasters with more than 999 Fatalities

(1900-2001)

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<td>1984</td>
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*34% events in the Bay of Bengal*
*50% of Bay events in Bangladesh*
*91% Deaths in Bangladesh*
Damage due to Cyclones in excess of 1 billion US $ (1976-2001)

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<th>Total Damage Million US $</th>
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Case Studies of TC Impact
A case study of Andhra Pradesh
Cyclone of December 2003
Information From DSS include …

• Population to be affected
• Densely populated villages
• Areas under threat
• Threat to Crops
• Damage to Structures
• Rail and Road network in the affected areas
• Vulnerable points
• Cyclone shelters
WIND HAZARD MODEL
DAMAGING WIND SPEEDS FOR CROPS
DUE TO SEVERE CYCLONIC STORM 12-15 DECEMBER 2003

LEGEND
- District Boundary
- Mandal Boundary

Damaging wind speeds for crops:
- 0 - 5 m/s
- 5 - 10 m/s
- 10 - 15 m/s
- 15 - 20 m/s
- 20 - 25 m/s
- 25 - 30 m/s
- 30 - 35 m/s
- 35 - 40 m/s
- 40 - 45 m/s
- 45 - 50 m/s
- 50 - 55 m/s
- 55 - 60 m/s
- 60 - 65 m/s
- 65 - 70 m/s
- 70 - 75 m/s
- > 75 m/s

DWS CROPS
WIND HAZARD MODEL
DAMAGE TO BANANA CROP (in hectares)
DUE TO SEVERE CYCLONIC STORM 12-15 DECEMBER 2003

LEGEND

- District Boundary
- Mandal Boundary

- Damage to banana crop
  - No significant damage
  - < 50 Hectares
  - 50 - 100 Hectares
  - 100 - 500 Hectares
  - 500 - 1000 Hectares
  - 1000 - 2000 Hectares
  - 2000 - 5000 Hectares
  - 5000 - 10000 Hectares
  - 10000 - 20000 Hectares
  - No Data

Map showing damage to banana crop in various districts.
WIND HAZARD MODEL
DAMAGE TO SUGARCANE CROP (in hectares)
DUE TO SEVERE CYCLONIC STORM 12-15 DECEMBER 2003

LEGEND
- District Boundary
- Mandal Boundary
- Damage to sugarcane crop
  - No significant damage
  - < 50 Hectares
  - 50 - 100 Hectares
  - 100 - 500 Hectares
  - 500 - 1000 Hectares
  - 1000 - 2000 Hectares
  - 2000 - 5000 Hectares
  - 5000 - 10000 Hectares
  - 10000 - 20000 Hectares
- No Data
WIND HAZARD MODEL
DAMAGE TO THATCHED HOUSES WITH MUD WALLS
DUE TO SEVERE CYCLONIC STORM 12-15 DECEMBER 2003

LEGEND

- District Boundary
- Mandal Boundary
- Damage to thatched houses - mud walls
  - No significant damage
  - < 100 Houses
  - 101 - 500 Houses
  - 501 - 1000 Houses
  - 1001 - 2000 Houses
  - 2001 - 5000 Houses
  - 5001 - 10000 Houses
  - 10001 - 20000 Houses
  - 20001 - 50000 Houses
  - No Data

Districts:
- East Godavari
- West Godavari
- Guntur
- Krishna

Map showing damage distribution across different districts.
Wind Vectors

Maximum Instantaneous Wind Speeds 1990 Cyclone
Inundation - East Godavari
Cycle: 1996110506
Rainfall Data from Cyclone Model Telemetry Data IMD Network Satellite Derived (region)

Developed and Calibrated 1:1Mil To develop for 1:250000 and 1:50000

Inflow into River Mouths

Additional Inputs from:
Measured Telemetry and Discharges Gauge Network from CWC, Hydrology Network from I&CAD

MIKE 11

3D-DEM Completed 1: 50K Process: 1:25 K (Coastal 20Km stretch only)

Flood Watch

GIS Offline Interface (Overlaying, Zooming and Other Data Input)

Quantification of Flooding Flood areas Depth/Duration/Extent

Advice/ Bulletins

Decision Support System

Simulated Flow Levels and possible Bank Overflows

River Channel Survey
Bank Levels

From cyclone models

Value Addition
• Damage Quantification,
• Advisories for facilitating relief routing,
• Increase in Lead time
• Delta Water Management and Water Quality Management
• Flood Control Strategies (long-term and short term mitigation plans)
Andhra Pradesh flood modelling

- 24 Rivers Modelled, including Godavari, Krishna, and Pennar
- Flood forecasting covering 14 districts
- Network of real-time river and rainfall gauges
- Rain gauges – 55 Nos
- River gauges/Tide Flow – 49 Nos
- Meteorological Stations – 5 Nos
- Real-Time Monitoring of River Flows
UP Model

• Upscaled Physically-based model designed:
  – to simulate water exchanges between the land surface and the atmosphere
  – to simulate lateral transfer of water, solutes and sediment
  – to be applicable from catchment-scale to continental-scale
UP Element

- Precipitation
- Evapotranspiration
- Soil water storage
- Surface runoff

**Diagram:**

1. Precipitation
2. Throughfall & Snowmelt
3. Evaporation & Transpiration
4. Interflow Discharge
5. Groundwater Discharge
6. Surface Runoff
7. Percolation & Capillary Rise
8. Inter-element Exchanges
MIKE 11 GIS

- Flood Mapping: MIKE 11-GIS
- Fully integrated GIS based flood modelling
- Centred on ArcView GIS
- Leverages full power of GIS for modelling
- Pre-processing: Floodplain schematization
- Post-processing: Inundation maps
  - Comparison maps
  - Duration maps
- Analysis with other GIS data
Basic data requirements for modelling

- River cross-sections
- Maps of floodplains
- Historical river flow data
- Tidal variations
- Data on structures along river that affect flow
River Pennar Model

- Model extends from Somasila to Bay of Bengal
- The total modelled length of the River Penneru is around 117 km
- Major structure is Somasila dam
- One existing CWC station at Nellore is present within model reach
FLOOD WATCH

A Management System for Real-Time Flood Forecasting and Warning

MIKE Flood Watch is a decision support system for real-time flood forecasting combining an advanced time series data base with the MIKE 11 hydro-dynamic modeling and real-time forecasting system, MIKE11 FF together with the Geographical Information System (GIS), Arc View GIS.
The Strengths of MIKE Flood Watch

A fast and reliable system for real-time operation
Direct-access time series database
Integration with external databases, e.g. Oracle
Automatic import of telemetric data
Data quality control and data processing facilities
GIS presentation facilities
Automatic forecasting and storage of results
Dissemination of flood maps, flood warnings, bulletins and graphics on the World
Front page of District Level flood inundation report
e.g. District Collectors, district government offices
Nellore District Flood Inundation Map

River Pennar
River Kandaleru
River Swarnamukhi
DSS Outputs – District Level

GOVERNMENT OF ANDHRA PRADESH - DISASTER MANAGEMENT UNIT
FLOOD & CYCLONE MONITORING CENTRE

KHAMMAM
1989/07/24 at 00:00

Current | 0-24 HRS | 24-48 HRS | 48-72 HRS | Bulletin | Up

Flood Status
- Severe
- Moderate
- Alert level
- No flooding
- No data

Map showing flood status in different districts.
GOVERNMENT OF ANDHRA PRADESH - DISASTER MANAGEMENT UNIT
FLOOD & CYCLONE MONITORING CENTRE

FLOOD ADVISORY BULLETIN

DISTRICT REPORT

KHAMMAM DISTRICT (PAGE 1 OF 3)

Forecast at: 1989/07/24 at 00:00

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NOTES:
1. Showing worst situation in time period shown
2. Blank box indicates no flooding imminent
3. 'A' indicates alert level reached
4. 'M' indicates moderate flooding expected
# Bulletin Types

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<tr>
<th>BULLETIN No.</th>
<th>CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Routine Daily State-wide Report based on both Districts and Catchments/Areas</td>
</tr>
<tr>
<td>2</td>
<td>Specific District Report with Mandal forecast information</td>
</tr>
<tr>
<td>3</td>
<td>District Report with indicative Mandal inundation data</td>
</tr>
<tr>
<td>4</td>
<td>District Report with indicative Mandal ‘assets at risk’ assessment</td>
</tr>
<tr>
<td>5</td>
<td>Catchment/Area based Flood Forecasting Station Report</td>
</tr>
</tbody>
</table>
HMIS

Hazard Mitigation Information System is a network connecting all the district and Mandal Head quarters with Secretariat and other Heads of Departments through APSWAN for faster and efficient dissemination of information throughout the Andhra Pradesh
Dissemination of Model Outputs

The outputs of all the models analysed through DSS with the help of GIS database are linked to HMIS for faster dissemination to the concerned authorities.
Asia: Issues for TC impact on Agriculture

- Data collection and storage from the region
- Early Warning System for Agriculture?
- Multi-sectoral, multi-country, multi-institutions participation
- Vulnerability and disaster mapping
- Insurance
Regional Groupings / Fora

- SAARC
- AASIAN
- BIMSTEC
- WMO/ESCAP Panel
BIMSTEC

Bay of Bengal Initiatives for Multi-Sectoral Technical and Economic Cooperation
Medium Range Prediction and Drought Monitoring in India
Agromet Advisory Service (AAS) in India
Agromet Advisory Service (AAS) Network

Total Units: 107
Salient Features of Agromet
Advisory Service (AAS)

• At present in 107, but plans to cover all 127 agro-climatic zones.

• Units are opened in State Agricultural Universities and ICAR Institutes.

• NCMRWF issues location specific quantitative weather forecasts upto one week in advance twice a week.

• AAS Units translate these forecasts into Agro-advisories and disseminate them to Media and also directly to farmers.

• Units run Crop Weather Models and include output in the Day today advisories.
NCMRWF FORECAST PRODUCTS
DISSEMINATED TO AAS UNITS

- 24 HR PRECIPITATION (MM)
- AVERAGE CLOUDINESS (OKTA)
- AVERAGE WIND SPEED (KMPH) AT 10 FT HEIGHT
- PREDOMINANT WIND DIRECTION (DEG.) AT 10 FT HEIGHT
- MAXIMUM TEMPERATURE TREND (DEG. C) AT 4.5 FT HEIGHT
- MINIMUM TEMPERATURE TREND (DEG. C) AT 4.5 FT HEIGHT

Frequency of Forecast: Twice-a-week
Dissemination: On Tuesday and Friday
Period covered: 4 days
AGROMETEOROLOGICAL ADVISORY SERVICE OF NCMRWF

NCMRWF
PREPARATION OF LOCATION SPECIFIC FORECAST

VSAT FAX PHONE

AAS UNITS (SAUs / ICAR institutes)
PREPARATION OF AGROMET ADVISORY BULLETIN

FEEDBACK FROM FARMERS/ AAS UNIT

FARMERS’ FEEDBACK

AIR T.V. PRINT PERSONAL CONTACT

FARMERS
FORMAT FOR AGROMET ADVISORY BULLETIN

- WEATHER INFORMATION
  - Weather summary of preceding week,
  - Climatic normal for the week,
  - Weather forecast and
  - Crop moisture index, Drought severity index etc.

- CROP INFORMATION
  - Type, state and phenological stages of the crops
  - Information on pest and disease and
  - Information on crop stresses

- ADVISORY BULLETIN
  - Crop-wise farm management information tailored to weather sensitive agricultural practices like sowing, irrigation scheduling, p & d control operation, fertilizer use etc.
  - Spraying condition for insect, weed and their products
  - Wildfire rating forecasts in wildfire prone areas
  - Livestock management information for housing, health and nutrition etc.
Weather Events covered in AAS

- Frost / Cold Wave
- Heat Wave
- Heavy Rain / Snowfall
- Dry Spell
- Strong Winds
- Hail
- Cyclone
# Crops/ Livestock covered under AAS

<table>
<thead>
<tr>
<th>Field crops</th>
<th>Vegetables</th>
<th>Horticultural</th>
<th>Livestock</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td>Tomato</td>
<td>Apple</td>
<td>Avian Birds</td>
</tr>
<tr>
<td>Wheat</td>
<td>Cauliflower</td>
<td>Mango</td>
<td>Sheep/ Goat (wool, meat)</td>
</tr>
<tr>
<td>Sorghum</td>
<td>Potato</td>
<td>Grapes</td>
<td>Cow / Buffalow (milk)</td>
</tr>
<tr>
<td>Millet</td>
<td>Toria</td>
<td>Orange</td>
<td></td>
</tr>
<tr>
<td>Maize</td>
<td>Onion</td>
<td>Coconut</td>
<td></td>
</tr>
<tr>
<td>Barley</td>
<td>Beans</td>
<td>Guaua</td>
<td></td>
</tr>
<tr>
<td>Gram</td>
<td>Ginger</td>
<td>Papaya</td>
<td></td>
</tr>
<tr>
<td>Soybean</td>
<td>Peas</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Groundnut</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sesam</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cowpea</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mustard</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Major Agricultural Operations covered under AAS

- **Sowing / Transplanting**
  - Rainfed
  - Irrigated
- **Pest & Disease**
  - Spraying
- **Water Management**
  - Irrigation
- **Fertiliser Application**
- **Harvesting**
- **Post Harvesting / Storage**
ECONOMIC IMPACT ASSESSMENT OF AAS

Based on Farmer's feedback, Field visits by scientists, Objective techniques (Crop cutting and Saving due to reduction in farm inputs) and Notional savings

<table>
<thead>
<tr>
<th>FIELD UNIT</th>
<th>Crops/ Livestock</th>
<th>Weather Events/ Management Practices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kovilpatti</td>
<td>Sorghum, Cotton</td>
<td>Early sowing</td>
</tr>
<tr>
<td>Ludhiana</td>
<td>Potato, Tomato</td>
<td>Frost</td>
</tr>
<tr>
<td>Coimbatore</td>
<td>Sorghum, Maize, Banana, Onion</td>
<td>Early sowing, Wind speed, Cloudiness</td>
</tr>
<tr>
<td>Madras</td>
<td>Poultry</td>
<td>Thermal stress, Pest &amp; Disease management</td>
</tr>
<tr>
<td>Namakkal</td>
<td>Poultry</td>
<td>Heat stroke, Disease management</td>
</tr>
<tr>
<td>Pune</td>
<td>Sorghum</td>
<td>Dry sowing</td>
</tr>
<tr>
<td>Raipur</td>
<td>Chilli, Potato</td>
<td>Irrigation, Wind speed, Cloudiness</td>
</tr>
<tr>
<td>Anand</td>
<td>Pigeonpea, Cotton, Potato</td>
<td>Pesticide application</td>
</tr>
</tbody>
</table>

SAVINGS ACHIEVED: 2-20%
Medium Range Forecast and Drought Monitoring during MONSOON 2005
Onset and Advance of Monsoon

- Late onset over Kerala by about 4 days (5<sup>th</sup> June)
- Delayed advance over northeast India by about two weeks (16<sup>th</sup> June)
- Monsoon arrived over Mumbai late by 9 days (19<sup>th</sup> June)
Onset and Advance of Monsoon

Onset over central India Delayed by about 10-15 days (20\textsuperscript{th} - 24\textsuperscript{th} June)

Delayed onset over northern plains by about 7 to 10 days

Normal Onset over parts of Northwest India including Delhi

Monsoon covered entire country by 30\textsuperscript{th} June, 15 days ahead of normal date.
Progress of Monsoon over different parts of the Country

MONSOON-2005
Monsoon-2005: A Glimpse

Country as a whole rainfall Distribution:
Normal for 1 June-28 September = 884.4 mm
Actual rainfall = 872.8 mm
% Dep. From Normal = -1%

Zone-wise rainfall distribution

<table>
<thead>
<tr>
<th>Zone</th>
<th>Normal</th>
<th>Actual</th>
<th>% Dep</th>
</tr>
</thead>
<tbody>
<tr>
<td>North-west</td>
<td>608.7</td>
<td>550.0</td>
<td>-10%</td>
</tr>
<tr>
<td>Central</td>
<td>985.6</td>
<td>1092.2</td>
<td>+11%</td>
</tr>
<tr>
<td>South Peninsula</td>
<td>711.2</td>
<td>798.5</td>
<td>+12%</td>
</tr>
<tr>
<td>North-east India</td>
<td>1415.7</td>
<td>1122.9</td>
<td>-21%</td>
</tr>
</tbody>
</table>

Sub-Division wise rainfall distribution

<table>
<thead>
<tr>
<th>Class</th>
<th>Value</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excess</td>
<td>9</td>
<td>25%</td>
</tr>
<tr>
<td>Normal</td>
<td>23</td>
<td>64%</td>
</tr>
<tr>
<td>Deficient</td>
<td>4</td>
<td>11%</td>
</tr>
<tr>
<td>Scanty</td>
<td>0</td>
<td>0%</td>
</tr>
</tbody>
</table>

District wise rainfall distribution

<table>
<thead>
<tr>
<th>Class</th>
<th>Value</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excess</td>
<td>110</td>
<td>22%</td>
</tr>
<tr>
<td>Normal</td>
<td>249</td>
<td>50%</td>
</tr>
<tr>
<td>Deficient</td>
<td>133</td>
<td>26%</td>
</tr>
<tr>
<td>Scanty</td>
<td>11</td>
<td>2%</td>
</tr>
<tr>
<td>No Rain</td>
<td>0</td>
<td>0%</td>
</tr>
</tbody>
</table>
Exceptionally Heavy rains in Indian Metros-2005

- Mumbai: 26 July
- Delhi: 15 September
- Visakhapatnam: 16 October
- Kolkata: 21 October
- Bangalore: 22 October
- Chennai: 26 October
<table>
<thead>
<tr>
<th>Week ending</th>
<th>All India % rainfall departure</th>
<th>No of deficient/scanty subdivisions</th>
<th>% Realized Rainfall out of Season’s Normal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Weekly</td>
<td>Cumulative for the period beginning from 1 June</td>
<td>Weekly cumulative for the period beginning from 1 June</td>
</tr>
<tr>
<td>1</td>
<td>08-6-2005</td>
<td>-54</td>
<td>-51</td>
</tr>
<tr>
<td>2</td>
<td>15-6-2005</td>
<td>-67</td>
<td>-59</td>
</tr>
<tr>
<td>3</td>
<td>22-6-2005</td>
<td>-31</td>
<td>-49</td>
</tr>
<tr>
<td>4</td>
<td>29-6-2005</td>
<td>+32</td>
<td>-20</td>
</tr>
<tr>
<td>5</td>
<td>06-7-2005</td>
<td>+34</td>
<td>-2</td>
</tr>
<tr>
<td>6</td>
<td>13-7-2005</td>
<td>+3</td>
<td>+1</td>
</tr>
<tr>
<td>7</td>
<td>20-7-2005</td>
<td>-6</td>
<td>0</td>
</tr>
<tr>
<td>8</td>
<td>27-7-2005</td>
<td>+1</td>
<td>+2</td>
</tr>
<tr>
<td>9</td>
<td>03-8-2005</td>
<td>+16</td>
<td>+5</td>
</tr>
<tr>
<td>10</td>
<td>10-8-2005</td>
<td>-25</td>
<td>+2</td>
</tr>
<tr>
<td>11</td>
<td>17-8-2005</td>
<td>-46</td>
<td>-2</td>
</tr>
<tr>
<td>12</td>
<td>24-8-2005</td>
<td>-17</td>
<td>-3</td>
</tr>
<tr>
<td>13</td>
<td>31-8-2005</td>
<td>-51</td>
<td>-6</td>
</tr>
<tr>
<td>14</td>
<td>07-9-2005</td>
<td>-27</td>
<td>-8</td>
</tr>
<tr>
<td>15</td>
<td>14-9-2005</td>
<td>+34</td>
<td>-5</td>
</tr>
<tr>
<td>16</td>
<td>21-9-2005</td>
<td>+61</td>
<td>-2</td>
</tr>
<tr>
<td>17</td>
<td>28-9-2005</td>
<td>-1</td>
<td>-1</td>
</tr>
<tr>
<td>S. No.</td>
<td>Met Sub-divisions</td>
<td>%Cumulative Rainfall Dep. From normal as on 24 Aug.,2005</td>
<td>%Cumulative Rainfall Dep. From normal as on 31 Aug.,2005</td>
</tr>
<tr>
<td>-------</td>
<td>-----------------------------------------</td>
<td>----------------------------------------------------------</td>
<td>----------------------------------------------------------</td>
</tr>
<tr>
<td>1</td>
<td>West U.P.</td>
<td>-20% (D)</td>
<td>-26% (D)</td>
</tr>
<tr>
<td>2</td>
<td>West Rajasthan</td>
<td>-28% (D)</td>
<td>-34% (D)</td>
</tr>
<tr>
<td>3</td>
<td>East Rajasthan</td>
<td>-10% (N)</td>
<td>-17% (N)</td>
</tr>
<tr>
<td>4</td>
<td>Haryana, Chandigarh and Delhi</td>
<td>-12% (N)</td>
<td>-18% (N)</td>
</tr>
<tr>
<td>5</td>
<td>West Madhya Pradesh</td>
<td>-12% (N)</td>
<td>-19% (N)</td>
</tr>
<tr>
<td>6</td>
<td>East Madhya Pradesh</td>
<td>+32% (E)</td>
<td>+22% (E)</td>
</tr>
<tr>
<td>7</td>
<td>Gujarat</td>
<td>+42% (E)</td>
<td>+33% (E)</td>
</tr>
<tr>
<td>8</td>
<td>Orissa</td>
<td>-5% (N)</td>
<td>-10% (N)</td>
</tr>
<tr>
<td>9</td>
<td>Chattisgarh</td>
<td>-11% (N)</td>
<td>-17% (N)</td>
</tr>
<tr>
<td>10</td>
<td>Telangana</td>
<td>+14% (N)</td>
<td>+9% (N)</td>
</tr>
<tr>
<td>11</td>
<td>Marathwada</td>
<td>+12% (N)</td>
<td>+6% (N)</td>
</tr>
<tr>
<td>12</td>
<td>Vidarbha</td>
<td>+7% (N)</td>
<td>0% (N)</td>
</tr>
<tr>
<td>13</td>
<td>Bihar</td>
<td>-20% (D)</td>
<td>-11% (N)</td>
</tr>
<tr>
<td>14</td>
<td>Rayalaseema</td>
<td>+16% (N)</td>
<td>+26% (E)</td>
</tr>
<tr>
<td>15</td>
<td>South Interior Karnataka</td>
<td>+27% (E)</td>
<td>+34% (E)</td>
</tr>
<tr>
<td>16</td>
<td>Tamilnadu &amp; Pondicherry</td>
<td>-30% (D)</td>
<td>-11% (N)</td>
</tr>
<tr>
<td>S.No.</td>
<td>Sub-Divisions</td>
<td>R/F % Dep. for the period 1 June-14 September</td>
<td>Assessment of situation till end of next week based on current weather situation and medium range prediction of rains for next week</td>
</tr>
<tr>
<td>-------</td>
<td>---------------------------------------</td>
<td>----------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>1</td>
<td>Assam &amp; Meghalaya</td>
<td>-24%</td>
<td>Sub-due rainfall activity is expected during next week. Not much improvement likely</td>
</tr>
<tr>
<td>2</td>
<td>Nagaland, Manipur, Mizoram &amp; Tripura</td>
<td>-29%</td>
<td>Some rainfall activity is expected during next week. Marginal improvement likely</td>
</tr>
<tr>
<td>3</td>
<td>Jharkhand</td>
<td>-33%</td>
<td>Scattered rainfall activity is likely during the week. Marginal improvement likely</td>
</tr>
<tr>
<td>4</td>
<td>Bihar</td>
<td>-20%</td>
<td>Scattered rainfall activity is likely during the week. Marginal improvement likely</td>
</tr>
<tr>
<td>5</td>
<td>East Uttar Pradesh</td>
<td>-22%</td>
<td>Currently experiencing scattered to fairly widespread rains and the same conditions are likely to prevail. Some improvement likely</td>
</tr>
<tr>
<td>6</td>
<td>West Uttar Pradesh</td>
<td>-29%</td>
<td>Currently experiencing fairly widespread with isolated heavy rains and the same conditions are likely to prevail. Good improvement likely</td>
</tr>
<tr>
<td>7</td>
<td>West Rajasthan</td>
<td>-27%</td>
<td>Isolated to Scattered rainfall activity is expected during the week. Some improvement likely</td>
</tr>
<tr>
<td>8</td>
<td>East Rajasthan</td>
<td>-21%</td>
<td>Scattered to fairly widespread rainfall activity is expected during the week. Good improvement likely</td>
</tr>
<tr>
<td>9</td>
<td>West Madhya Pradesh</td>
<td>-21%</td>
<td>Scattered to fairly widespread rains are expected during the week. Good Improvement likely</td>
</tr>
</tbody>
</table>
Future Plans:
Proposed District Level Forecast and AAS
Proposed District-level Agro-advisory System of NCMRWF

107 AAS UNITS

District Agriculture Offices of State Governments

FARMERS
(through media, extension services, personal contact)

Feedback analysis

PREPARATION OF DISTRICT LEVEL AGRO-ADVISORIES

PREPARATION OF DISTRICT WISE MEDIUM RANGE WEATHER FORECAST

PREPARATION OF AGRO-CLIMATIC ZONE LEVEL AGRO-ADVISORIES

Agro-climate level agro-met data

Agro-met data
Pilot Initiative for Village Information System

A new programme launched by DST in collaboration with AP Govt.
Pilot Initiative for Village Information System
(Jointly with NRDMS, SOI, APSRAC, APCOST)

1. Study Area: 10 Villages of Nellore Districts of AP for Cyclone & flood vulnerability assessment 10 Villages of Cuddapa District of AP for drought vulnerability assessment

2. Information to be bundled in addition to existing resources and other data at Village level-
   a. Risk & vulnerability assessment
   b. Mapping of Village scale risk & vulnerability
   c. Details of best practices in respect of effective community level response to the disaster scenario
   d. Risk Mapping of infrastructure, houses, crops, & other common facilities
   e. Mitigation Plans to reduce risk & vulnerability for evolving suitable developmental plans

3. Computing & Network infrastructure establishment
A Typical Layout of REVENUE VILLAGES
Topographic Layers

• Habitation
• Revenue Village
• Settlements
• Roads
• Rail Network
• Canal
• Drainage Lines
• Water Bodies
• Wells
• Forest
• Contour
• Elevation
• Symbol
Thematic Layers from Satellite Images

- Hydrogeomorphology
- Slope
- Soil
- Land Use / Land Cover
- Land and Water Resources Development Plans
Non-Spatial Data for every Habitation

- Census
- Land Information
- Infrastructure
Census

- No. of Households
- Population
- Male/ Female
- Age
- Caste
- Literacy
- Work Force
Land Use

- Total Geographical Area
- Forest Area
- Barren and Unculturable Waste Land
- Land put to Non-Agricultural Uses
- Culturable Waste Land
- Permanent Pastures / Grazing Lands
- Land put to Miscellaneous use (Trees/ Groves)
- Fallow land
- Net Area Sown
- Irrigated Land
  (Canals, Tanks, Tube wells, Wells, Check dams, L.I. Schemes)
Infrastructure

- Schools
- Colleges
- Hostels
- Health Institutions
- Veterinary Institutions
- Electricity
- Police Station
- Post Office
- Telephone
- Fire Station
- Banks
- Drinking Water Sources
- Irrigation Sources
- Industries
- Public Distribution System
Infrastructure

- Bus Services
- Women & Child Development Centres
- Non-formal Education Centres
- Village Library
- Rail Services
- Market Yards
- Cooperative Institutions
- Self Help Groups
- Rural Connectivity
- Cable T.V.
- Burial Ground
- Garbage Yard
- Community Latrines
Classification of mandals based on average annual rainfall (mm)
Ground Water Status of Different Mandals of A.P.
Rural water supply (percent habitations fully covered)
Thanks for your kind attention!